

# Memorandum

Date : January 10, 2002

To : Julie Cunningham  
Department of Fish and Game

Frank L. Glick, Chief  
Project Geology Section, Division of Engineering

From : Department of Water Resources

Subject: Lake Davis, Review of Proposal to Use Detonation Cord

## Introduction

Thank you for contacting the Project Geology Section in the Department of Water Resources' Division of Engineering to assist you with the proposed use of detonation cord in Lake Davis. The use of "det cord" should provide the overpressure required for your purpose of killing fish. The proposed layout of the det cord allows coverage over a reservoir surface area of one acre or more without any high single point source where energy would be concentrated. The main purpose of our involvement is to make sure that there will be no impact to DWR's Grizzly Valley Dam and related facilities. We have also reviewed the excerpts from the draft Initial Study dated December 20, 2001 that you provided to us; please see the attached sheet for specific comments.

## Analysis of Using Detonation Cord

All explosives, including det cord, generate P-waves and shear waves. However, in water only the P-Waves are propagated beyond the source of the explosive. Shear waves are not propagated in water. Also, P-waves are much less damaging to structures than shear waves. P-wave velocities in water are relatively slow, around 4,800 feet per second (fps). As stated in your proposed plan, the det cord itself detonates at 23,000 fps, significantly faster than the P-wave it will generate.

To determine the effect of an explosive on a nearby structure such as a dam, two factors need to be analyzed: the amount (weight) of explosive and the distance to the structure. This is done by calculating the Scale Distance (SD) based on the formula  $R/W^{1/3}$  (cube root) where R is the distance from shot to structure, and W is the total weight of shot per delay. For example, using the maximum charge possible for a focused point source of 7.5 pounds of explosive for 1,000 linear feet of det cord, and a minimum distance of one mile (5,280 feet) from the dam, this results in a calculated SD of nearly 2,700. This SD when plotted on Scale Distance vs. Peak Particle Velocity (PPV) graph indicates the PPV will be barely measurable, if at all, at the dam.

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Measuring a blast is accomplished by recording the PPV of the soil, rock, or structure in inches per second. The lowest PPV that can be related to damage of a structure is 2 inches per second for an un-reinforced plaster wall. Earthfill dams such as the Grizzly Valley Dam and its reinforced concrete structures can typically accept a PPV of at least 8 inches per second without sustaining damage. To add a level of conservancy, we will say the PPV at the dam and associated facilities should be no higher than 6 inches per second. We estimate the PPV for an SD of approximately 2,700 (see example above) is estimated to be below 0.01 in/sec.

Two additional factors need to be considered in the proposed use of underwater det cord. First is the fact that the cord will be laid out in lines and therefore is not considered a point source. This situation will reduce the impact of the blast at the dam and structures. Second will be the orientation of the det cord which can have a significant roll in the direction of P-wave generation and transmission. Det cord lines running perpendicular to the dam and structures will result in lower P-waves than lines running parallel to the dam and structures.

Also, it should be noted that multiple, parallel det cord lines over a large area will kill more fish but should not increase the overall PPV resulting from the blast. The propagating P-waves between parallel det cord lines, will probably experience some destructive interference as they collide with each other and totally cancel or reduce the multiple waveforms generated from a multi-line blast.

#### Field Monitoring

The first test shot should be monitored by Project Geology staff in conjunction with DFG consultants. The best locations will be at the closest soil or rock along the shore of the lake to the blast, and at the closest location on the dam. The distances from the blast to these locations will be determined and the amount of explosives to be used will be known so a Scale Distance is obtainable. The estimated resulting PPV will be compared to actual PPV data recorded in instruments provided by DFG consultants set up at the sites. This procedure will provide us with a site-specific correlation between expected and actual values which can be used to better-predict future blasts in the lake. This information can also be used in the development of SD and PPV for possible shots closer than one mile to DWR structures.

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### Conclusions and Recommendations

Based on our review of the draft plan you provided to Project Geology, and our subsequent analysis, we have the following conclusions and recommendations:

- The first test blast as currently proposed, and future blasts at least one mile from DWR's Grizzly Valley Dam, should cause no damage to the dam and related structures.
- The first test blast should be field-monitored by DWR/Project Geology staff in conjunction with DFG consultants to verify our analysis and to better-estimate the effects of future blasts.
- The potential effects on non-DWR structures have not been analyzed by DWR/Project Geology. This should be done by DFG consultants prior to all blasts.
- DWR/Project Geology may need to monitor addition blasts depending on the results of the first blast and the details of future proposed blasts.
- Additional analysis should be performed before any blast is allowed to proceed closer than one mile to the dam.

We hope this memorandum provides you with the information you need. Please feel free to call Bob Conover on my staff at (916) 323-8963 or me at (916) 323-8928 if you have any questions or need additional information.

### Attachment

cc: Ron Lee, DWR Civil Engineering Branch  
Les Harder, DWR Division of Engineering  
Teresa Sutliff, DWR Division of Operations and Maintenance  
Tom Glover, DWR Division of Operations and Maintenance  
Douglas Rischbieter, DWR Environmental Services Office

Review of Excerpts from DFG's Draft Initial Study  
January 10, 2002  
By Frank L. Glick

In general, the excerpts provided to DWR's Project Geology from DFG's Julie Cunningham looked fine to this reviewer. Specific comments are:

1. No comments on the "Detonation Cord" section.
2. "Implementation" Section, last paragraph: Please add DWR to the list of agencies to be consulted regarding vehicle access.
3. At the end of the "Phase I" Section, I suggest adding a paragraph titled "Ground Movement" (after the paragraph titled "Noise").
4. On Table 6 Geology and Soils, it should be clearly shown that there will be "NO IMPACT" from the use of detonation cord in Lake Davis on items "a" through "i". Your project will have absolutely no impact on earthquake faults, ground shaking as a result of earthquakes, liquefaction, soil erosion, loss of top soil, etc. One additional item that could be added is that your project will have no effect on the natural flow of groundwater, including into and out of water wells. Also, percolation rates associated with septic systems will not be effected by your project. These last two items may of concern to local residents.
5. In the "Methodology" and "Impact" Sections, you may change your reference to personal communications with me to a reference to this memorandum.
6. Please change your reference to me as a "registered engineering geologist" to "California Certified Engineering Geologist".